

CALIFORNIA STATE TEACHERS' RETIREMENT BOARD

INVESTMENT COMMITTEE

SUBJECT: Asset Allocation- Preliminary Report

ITEM NUMBER: 6

ATTACHMENT(S): 1

ACTION: _____

DATE OF MEETING: August 4, 1999

INFORMATION: X

PRESENTER(S): Mr. Emkin

EXECUTIVE SUMMARY

CalSTRS has an Investment Management Plan that serves as a blueprint for management of the investment portfolio. The Investment Management Plan includes a provision for a biennial asset allocation review to be completed by the Investment Committee. Today's presentation, by Pension Consulting Alliance (PCA), is the second of three asset allocation presentations. The objectives of this presentation include:

1. Recap of the July presentation on the asset allocation process
2. Review a spectrum of optimization approaches
3. Discuss various asset class expectations
4. Present initial results provided by the asset allocation modeling process

The material included as Attachment 1 identifies the minimum and maximum constraints, expected returns, expected risks, and expected correlation, efficient frontier analysis, and asset modeling scenarios. The expected risk and expected return for each consultant (Mercer, Callan, and PCA) is identified on page 8 of PCA's report. Expected correlation for the three consultants are listed on page 9. Constrained efficient frontier optimization results are included as pages 12 to 15.

Representatives from each consulting firm will be available for questions.

***CalSTRS* Asset Allocation Review - 1999**

Phase 2: An Initial Study of Optimization Results



to the CalSTRS Investment Committee

August 4, 1999

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Phase 2: An Initial Study of Optimization Results

Agenda:

- Review Concepts and Framework from July's Presentation
- Discuss Additional Asset Allocation Issues
- Review and Discuss initial optimization results

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Issues Addressed at the July Meeting:

- Purpose and Process of Establishing an Asset Allocation Policy
- Role and Return/Risk Expectations of Specific Asset Classes
- Use of Efficient Frontier Analysis as a Tool for Defining Policy
- Existing CalSTRS Policy in light of Historical Trends and Peer Funds

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Additional Asset Allocation Issues:

- A Spectrum of Optimization Approaches
- Different Investors Can Arrive at Different Asset Class Expectations

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The Spectrum of Optimization Approaches:

Asset-only mean-variance approach. The traditional approach used in asset allocation. Uses asset volatility as the measure of risk. Easy to understand, but overlooks integration of liabilities in some cases.

Downside risk mean-variance approach. Traditional approach modified to define risk using a pre-defined hurdle rate. Option to define risk in several ways: e.g., probability of underperformance, extent of underperformance, etc.

Downside risk generalized approach. One criticism of the traditional approach is that it assumes that all asset returns have normal distributions. Generalized approach allows user to define return distributions of asset classes in a non-normal fashion.

Dual downside mean-variance approach. Integrates downside risk approaches, which focus on assets, with downside risk analysis of liabilities. Key aspect of this approach is focusing on preserving surplus. Methodology incorporates immunization approaches. Key disadvantage: does not provide appropriate solutions when unfunded liability exists.

Integrated asset-liability approaches. There are two general methods for applying this type of approach. One method is to model liabilities as a bond equivalent and then reward/penalize assets for their ability to immunize the liability returns. A second approach assesses the impact of an asset mix on various financial ratios of the overall plan and may also determine how an asset mix might impact contribution levels under various scenarios. Each method requires input from the fund's actuary with the latter approach requiring significantly more input. The latter approach typically uses a single optimal portfolio and applies Monte-Carlo simulation to analyze a portfolio's impact on a plan's financial condition. The first method actually integrates liabilities into the portfolio optimization process to arrive at an optimal policy mix.

Multi-period approaches. Integrated or asset-only. Does not pre-define long-term risk behavior, but models asset and/or liability behavior period-by-period. Allows for significant sensitivity analysis across many inputs. Monte-carlo simulations used to determine outcomes. Multi-period approaches are highly complex and are often costly to execute.

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Comparison of Optimization Approaches:

Used by PCA →

Optimization Approach	Resource Requirements	Integration of liabilities	Complexity
<i>Asset-only mean variance</i>	Low	None	Low
<i>Downside risk mean-variance</i>	Low	Modest	Low
<i>Downside risk generalized</i>	Modest	Modest	Modest
<i>Dual downside mean-variance</i>	Significant	Significant	Significant
<i>Integrated asset-liability</i>	High	Significant/Substantial	Significant/Substantial
<i>Multi-period</i>	High	None/Substantial	None/Substantial

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Comparison of Optimization Approaches (cont.):

- Critical question: Does each approach produce materially different policies?
 - Answer: In most cases, no.

“Monte Carlo asset-liability simulation has many uses as a tool for financial planning. It is useful for understanding the likelihood of meeting funding objectives and likely cash flows associated with various fund investments and allocations. The procedure has limited value, however, as an alternative to Mean-Variance efficiency for defining an optimal asset allocation.”

Efficient Asset Management, Richard

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A Review of Consultant Expectations:

- Different return and risk expectations may lead to changes in asset allocation policy

Expected Returns and Risks*

	99 Callan	99 Mercer	99 PCA		Callan	Mercer	PCA
US Eq	10.93	11.80	9.75		16.30	19.50	20.00
Int'l Eq	12.51	12.30	9.90		21.50	23.00	22.00
US Fix	5.94	6.10	5.50		5.30	7.30	10.00
Alt Inv	18.98	18.30	13.75		36.00	35.00	30.00
Real Estate	9.56	8.50	9.75**		16.50	13.00	14.00**
Cash	4.60	4.50	4.00		0.70	2.00	1.50
Inflation	3.22	2.50	2.50		1.75	2.50	1.00

*Arithmetic single-period averages. Over the next ten years, in any one year, an asset class will be expected to produce its expected return and risk. For example, based on PCA's assumptions, there is a two-thirds chance that, in any one year, domestic equities will produce a return between minus (10.25%) and 29.75% with an average expected return of 9.75%.

**This assumption reflects CalSTRS' multi-risk strategy structure, per the CalSTRS1999 Real Estate Business Plan

- All consultants assign return premiums to international equities
 - range from 15bp (PCA) to 1.58% (Callan)
- PCA assigns different fixed-income return-risk attributes

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A Review of Consultant Expectations (cont.):

Expected Correlations

US Eq																					
Callan	1.00																				
Mercer	1.00																				
PCA	1.00	Int'l Eq																			
Callan	0.57	Callan	1.00																		
Mercer	0.50	Mercer	1.00																		
PCA	0.20	PCA	1.00	US Fix																	
Callan	0.33	Callan	0.30	Callan	1.00																
Mercer	0.50	Mercer	0.25	Mercer	1.00																
PCA	0.55	PCA	0.20	PCA	1.00	Alt Inv															
Callan	0.60	Callan	0.45	Callan	0.20	Callan	1.00														
Mercer	0.70	Mercer	0.25	Mercer	0.20	Mercer	1.00														
PCA	0.40	PCA	0.15	PCA	0.15	PCA	1.00	Real Estate*													
Callan	0.50	Callan	0.41	Callan	0.40	Callan	0.30	Callan	1.00												
Mercer	0.60	Mercer	0.20	Mercer	0.30	Mercer	0.50	Mercer	1.00												
PCA	0.20	PCA	0.20	PCA	0.15	PCA	0.85	PCA	1.00	Cash											
Callan	-0.12	Callan	-0.25	Callan	0.12	Callan	0.07	Callan	-0.06	Callan	1.00										
Mercer	0.00	Mercer	0.00	Mercer	0.10	Mercer	0.00	Mercer	0.20	Mercer	1.00										
PCA	0.40	PCA	0.00	PCA	0.15	PCA	0.10	PCA	0.10	PCA	1.00	Inflation									
Callan	-0.15	Callan	-0.23	Callan	-0.25	Callan	-0.13	Callan	-0.13	Callan	0.24	Callan	1.00								
Mercer	-0.20	Mercer	-0.40	Mercer	-0.35	Mercer	-0.10	Mercer	0.00	Mercer	0.60	Mercer	1.00								
PCA	-0.50	PCA	-0.40	PCA	-0.20	PCA	0.10	PCA	0.00	PCA	0.25	PCA	1.00								

*Reflects Multi-Risk Strategic Structure per 1999 CalSTRS Real Estate Business Plan

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Sensitivity Tests of the Optimization Process:

- Develop Efficient Frontiers Applying Specific Constraints
- Compare Efficient Frontiers Using Different Consultant Assumptions

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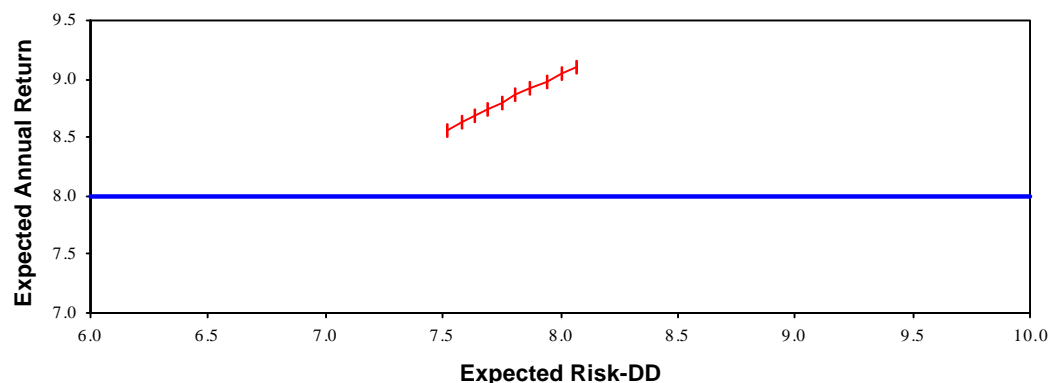
Must Introduce Constraints to Reflect Practical Issues:

Asset Class	Minimum %	Maximum %	Comments
Cash	1	1	Reflects policy to remain fully invested.
Fixed Income	20	100	Needed to provide income to plan.
Real Estate	2	5	Minimum reflects allocated, but not yet funded levels. Maximum reflects difficulty of funding asset class rapidly.
Domestic Equity	25	100	Needed to provide real growth to plan assets.
International Equity	0	35	Represents either risk-adjusted opportunity or diversifier.
Alternative Investments	2	5	Minimum reflects allocated, but not yet funded levels. Maximum reflects difficulty of funding asset class rapidly.

...constraints used in modeling process to identify ideal portfolio

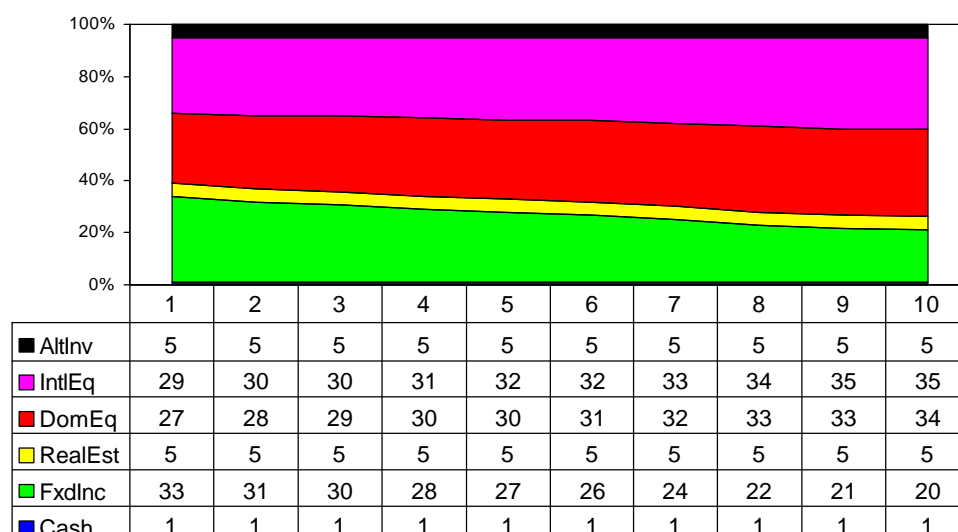
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Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	8.6	8.6	8.7	8.7	8.8	8.9	8.9	9.0	9.0	9.1
Prob. < 8%	45.1	44.9	44.8	44.7	44.5	44.4	44.3	44.1	44.0	43.9

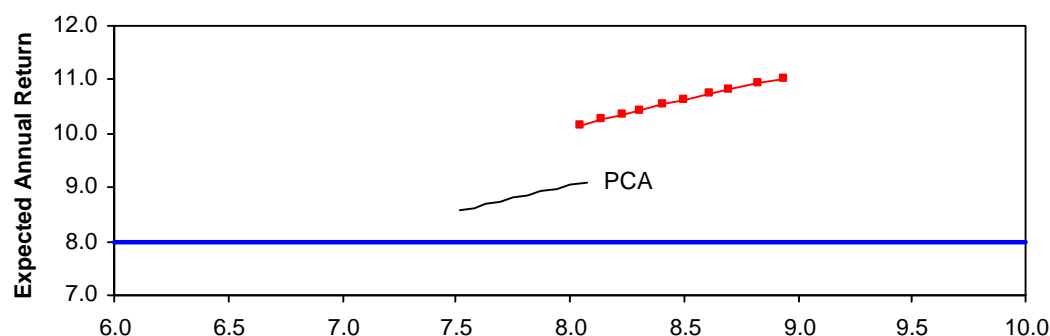
Sensitivity 1: Constrained Frontier PCA Assumptions



- 8% minimum return goal
- Following asset constraints:
 - 5% maximum in real estate
 - 5% maximum in alternatives
 - 1%-3% in cash
 - 25% minimum in domestic equity
 - 35% maximum in international equity
 - 20% minimum in fixed income

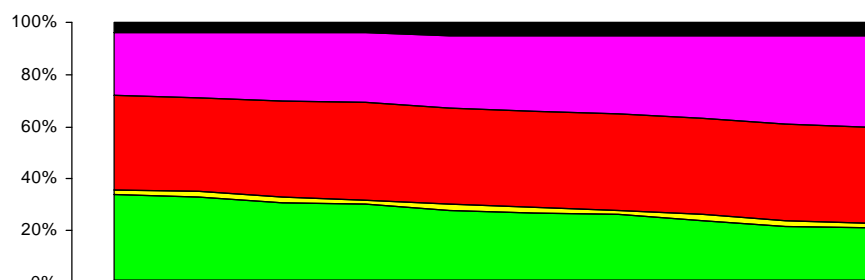
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Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	10.1	10.3	10.3	10.4	10.5	10.6	10.7	10.8	10.9	11.0
Prob. < 8%	43.8	43.6	43.4	43.2	43.1	42.9	42.7	42.6	42.4	42.3

Sensitivity 2: Constrained Frontier Mercer Assumptions

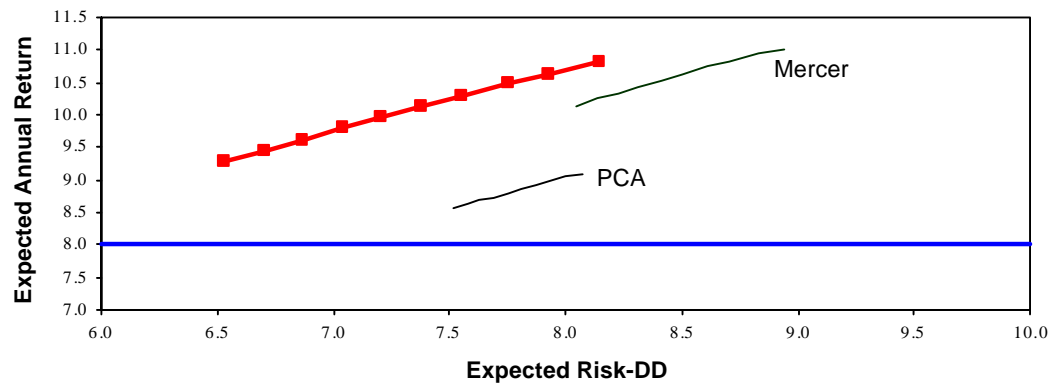


	1	2	3	4	5	6	7	8	9	10
AltInv	4	4	4	4	5	5	5	5	5	5
IntlEq	24	25	26	27	28	29	30	32	34	35
DomEq	36	36	37	37	37	37	37	37	37	37
RealEst	2	2	2	2	2	2	2	2	2	2
FxdInc	33	32	30	29	27	26	25	23	21	20
Cash	1	1	1	1	1	1	1	1	1	1

- 8% minimum return goal
- Following asset constraints:
 - 5% maximum in real estate
 - 5% maximum in alternatives
 - 1%-3% in cash
 - 25% minimum in domestic equity
 - 35% maximum in international equity
 - 20% minimum in fixed income

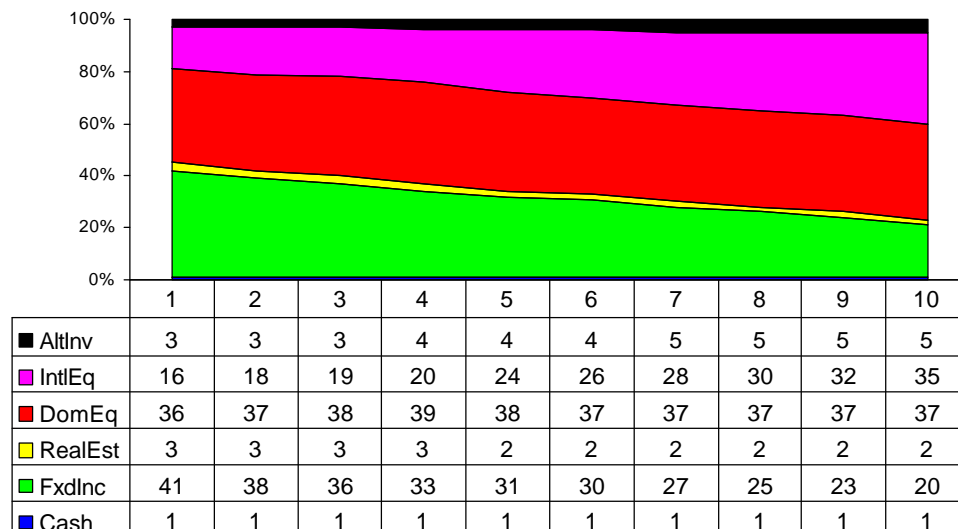
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Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	9.3	9.5	9.6	9.8	10.0	10.1	10.3	10.5	10.6	10.8
Prob. < 8%	45.3	44.9	44.5	44.1	43.7	43.3	43.0	42.7	42.4	42.2

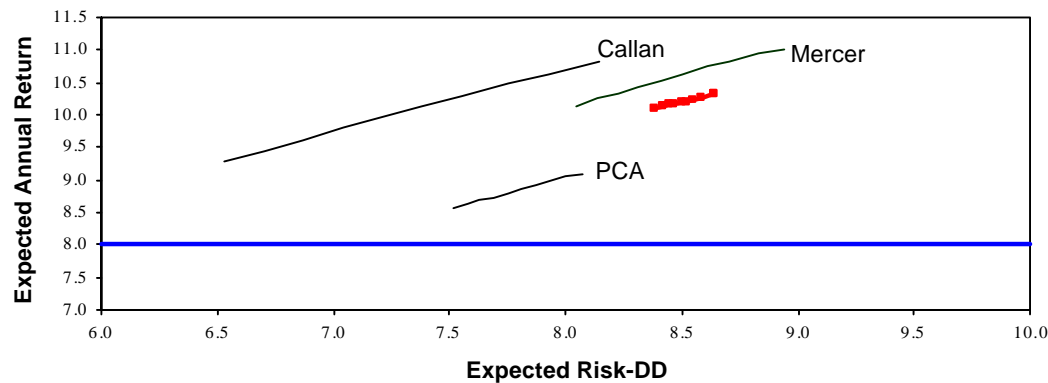
Sensitivity 3: Constrained Frontier Callan Assumptions



- 8% minimum return goal
- Following asset constraints:
 - 5% maximum in real estate
 - 5% maximum in alternatives
 - 1%-3% in cash
 - 25% minimum in domestic equity
 - 35% maximum in international equity
 - 20% minimum in fixed income

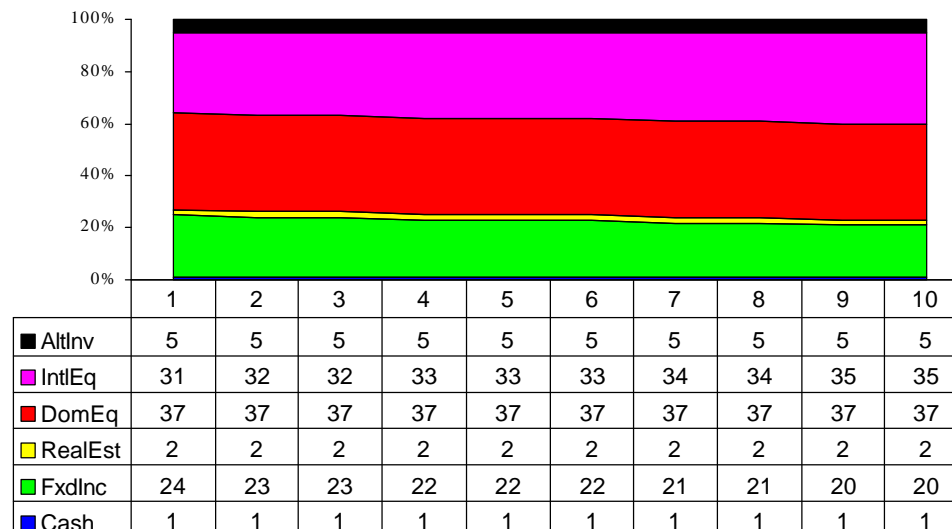
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Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	10.1	10.1	10.2	10.2	10.2	10.2	10.2	10.3	10.3	10.3
Prob. < 8%	44.1	44.1	44.0	44.0	44.0	43.9	43.9	43.8	43.8	43.8

Sensitivity 4: Constrained Frontier Composite Assumptions

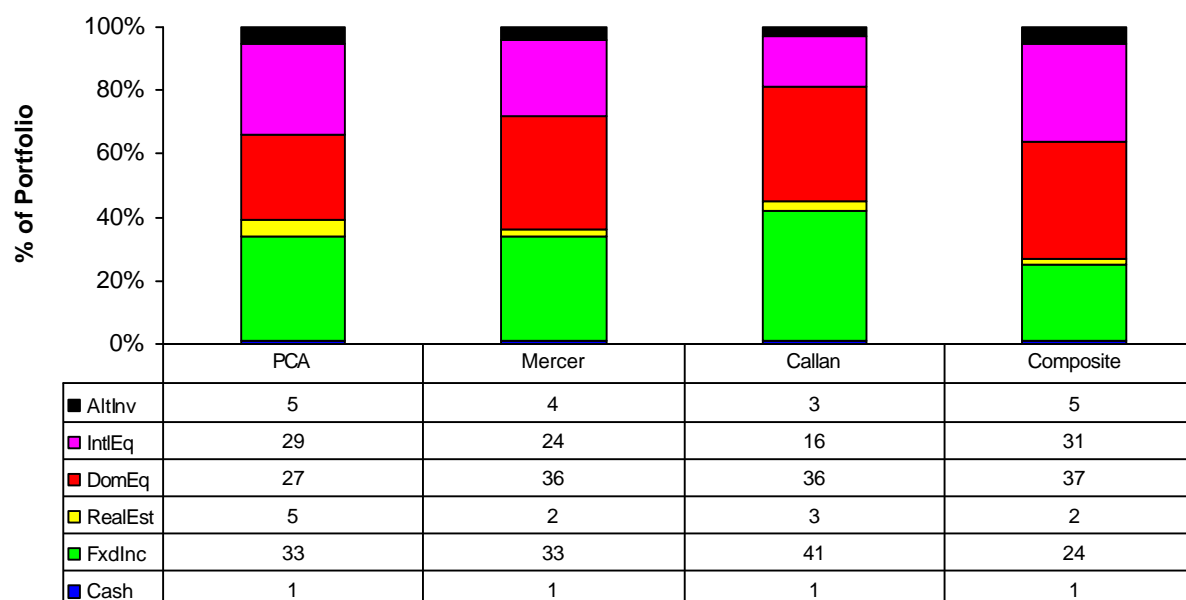


- 8% minimum return goal
- Following asset constraints:
 - 5% maximum in real estate
 - 5% maximum in alternatives
 - 1%-3% in cash
 - 25% minimum in domestic equity
 - 35% maximum in international equity
 - 20% minimum in fixed income

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Comparison of Low-Risk Portfolios

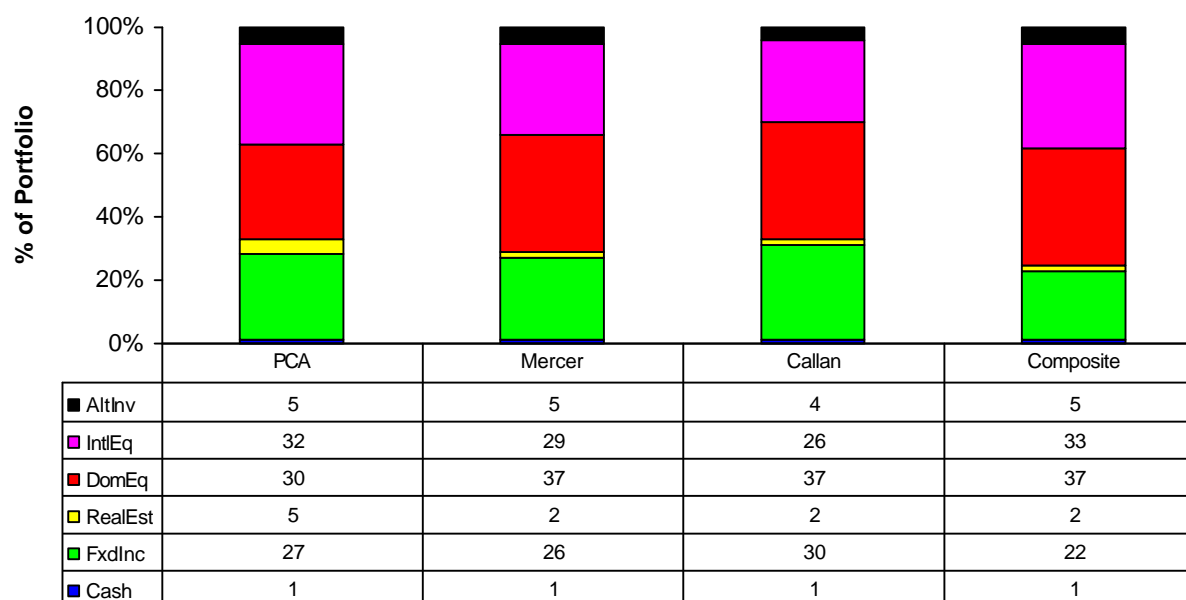


- Variations among all asset classes, PCA and Mercer have closest match
 - PCA assigns maximum to private classes (STRS structuring real estate more opportunistic)
- Spread between expected equity returns and required hurdle rate is an important factor
 - Higher Int'l equity risk premiums allow for less exposure to int'l equity, more to fixed income

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Comparison of Moderate-Risk Portfolios

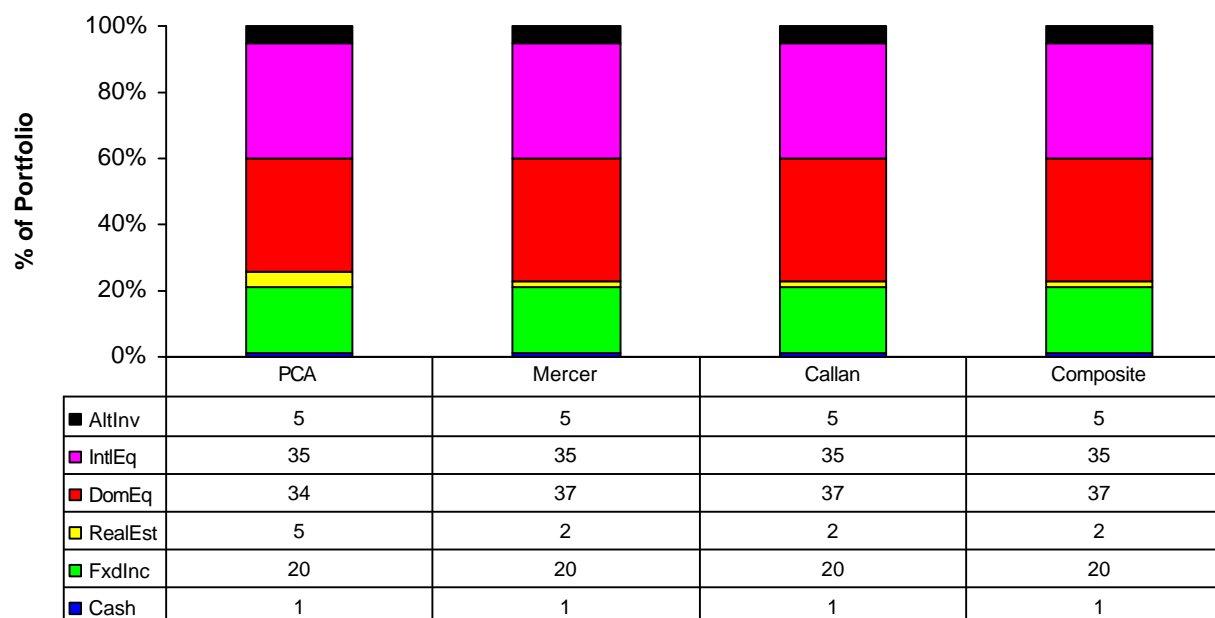


- Exposures to different classes in relatively tight ranges
 - major difference: allocation to real estate (due to STRS structure)
- Higher risk premiums for international equity allow diversification into fixed income

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Comparison of High-Risk Portfolios



- All portfolios hold at least 69% public equities; allocations between U.S./Intl. similar
 - only distinction: allocation to real estate

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Findings & Conclusions:

- Return and risk assumptions vary across consultants
 - lower expected returns causes lower-returning assets to be less attractive in light of 8% hurdle rate
 - result: higher reliance on equities (especially at low risk tolerance)
- Commonalities across risk types:
 - at low risk tolerance: at least 58% allocated to public and private equity
 - at mid risk tolerance: at least 69% allocation to public and private equity, allocations across consultants tighten
 - at high risk tolerance: virtually same portfolios, except for real estate structure issue
- Portfolio allocations highly sensitive to return assumptions (see next cases)
- Key issue in equity component:
 - Should the international equity's long-term premium over domestic equity exist?
 - What should the international premium be for policy-setting purposes?

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Requested Sensitivity Studies

- Eliminate equity premium versus fixed income
 - Still intact:
 - fixed income risk premium (vs. risk-free rate)
 - international risk premiums
- Limit international exposure to Developed International equity markets
 - adjust expectations by eliminating emerging markets

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Eliminate Equity Risk Premiums from Consultant Expectations:

Expected Returns and Risks with Equity Risk Premium Eliminated*

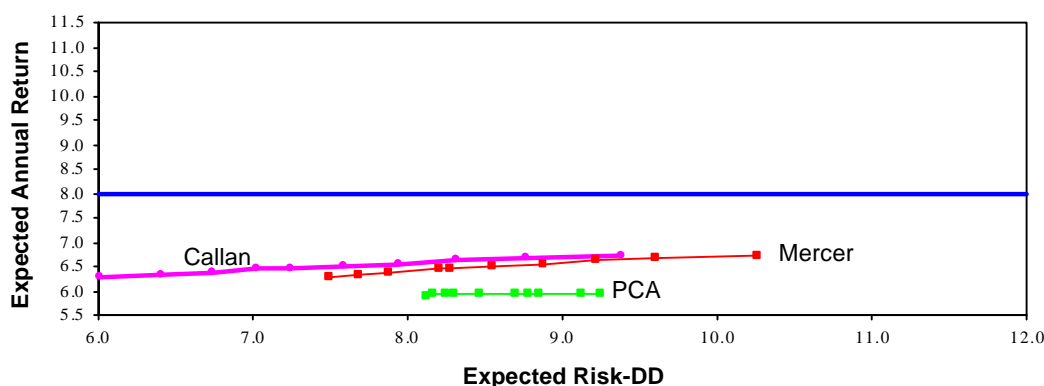
	99 Callan	99 Mercer	99 PCA		Callan	Mercer	PCA
US Eq	5.94	6.10	5.50		16.30	19.50	20.00
Int'l Eq	7.52	6.60	5.65		21.50	23.00	22.00
US Fix	5.94	6.10	5.50		5.30	7.30	10.00
Alt Inv	13.99	12.60	9.50		36.00	35.00	30.00
Real Estate	9.56	8.50	9.75		16.50	13.00	14.00
Cash	4.60	4.50	4.00		0.70	2.00	1.50
Inflation	3.22	2.50	2.50		1.75	2.50	1.00

*Arithmetic single-period averages.

- International risk premium and illiquidity risk premium still intact
 - Return premiums to international equities above and beyond the equity risk premium are still evident
 - Illiquidity premiums range from 4.0% to nearly 8.0%
 - Real estate now more attractive than public equity asset classes
 - Practical constraints will limit exposure to alternative investments and real estate

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PCA

Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	6.0	6.0
Prob. < 8%	58.1	58.0	58.0	58.0	57.8	57.6	57.5	57.3	57.0	56.9

Mercer

Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	6.3	.3	6.4	6.5	6.5	6.5	6.6	6.6	6.7	6.7
Prob. < 8%	57.8	57.2	56.8	56.2	56.1	55.7	55.3	54.9	54.5	54.1

Callan

Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1
Prob. < 8%	60.6	59.1	57.9	57.1	56.5	55.8	55.1	54.4	53.8	53.3

Sensitivity 5: Constrained Frontier Eliminate Equity Premium

- Same prior constraints
- Results:
 - All frontiers below 8.0% hurdle
- **Conclusion:**
 - Without equity premium attaining goal unlikely

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Use EAFE proxy Instead of ACWIxUS (i.e., Developed Mkts vs. Broader Non-U.S.)

Expected Returns and Risks Adjusting International Equities to ACWI Characteristics*

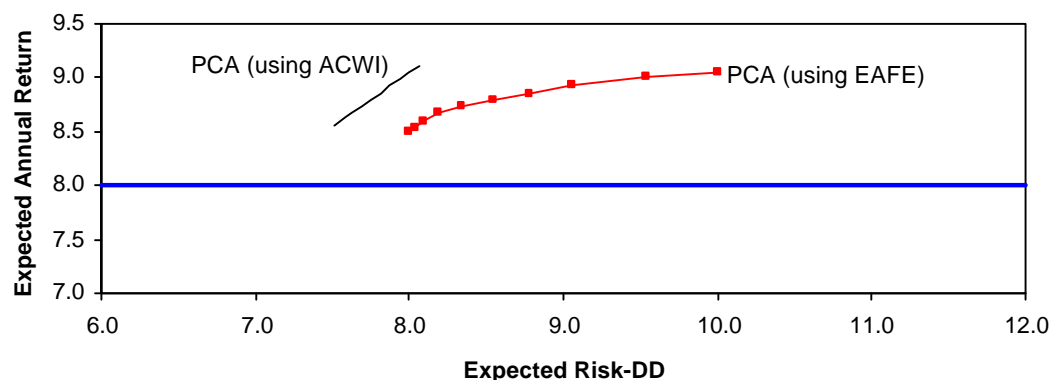
	99 PCA	PCA
US Eq	9.75	20.00
<i>Int'l Eq exEmerg</i>	9.65	20.00
<i>Int'l Eq w/ Emerg</i>	9.90	22.00
US Fix	5.50	10.00
Alt Inv	13.75	30.00
Real Estate	8.50	12.00
Cash	4.00	1.50
Inflation	2.50	1.00

*Arithmetic single-period averages.

- New assumptions extract attributes of emerging markets out of asset class
 - downward incremental return adjustment and reduce risk slightly
- Modest adjustments also made to correlation matrix

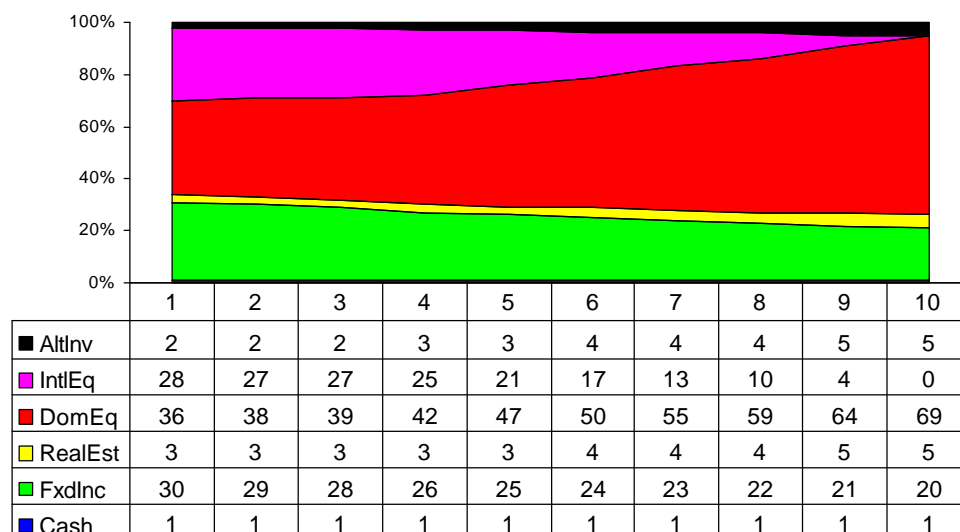
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Portfolio	1	2	3	4	5	6	7	8	9	10
Exp. Ret.	8.5	8.5	8.6	8.7	8.7	8.8	8.9	8.9	9.0	9.0
Prob. < 8%	45.6	45.4	45.3	45.1	45.1	45.0	45.0	45.0	45.0	45.1

Sensitivity 6: Constrained Frontier using **MSCI EAFE**



- Efficient frontier shifts right
 - highly sensitive to modest adjustments
 - only 25bp reduction in intl. eq. return
 - equivalent returns, but more risk
- Material difference in int'l equity allocation:
 - allocation declines over risk spectrum
 - falls to 0% at max. risk level
 - tradeoff comes from domestic equity

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Findings from Additional Sensitivity Studies:

- Realizing equity premium will be crucial to meeting long-term objectives
- Extending non-U.S. mandate to ACWIxUS-type proxy has strategic value
 - key points:
 - results acutely sensitive to modest shifts in expectations
 - even modest risk premium in international markets can have dramatic impact on mix